Graduate School MUSIC Multiscale Methods for Interface Coupling

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Die Graduiertenschule MUSIC lädt ein zum Vortrag im Seminar "Gekoppelte Probleme am Interface"

Donnerstag, 28. April 2011, 14:30 Uhr,
Graduiertenschule MUSIC, Appelstr. 11 A, Seminarraum A 501

Deformation patterning in non-convex strain gradient crystal plasticity

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During forming processes most metals develop cellular dislocation structures due to dislocation slip patterning. Typical examples of dislocation microstructures are dislocation cells and dislocation walls. Patterning typically refers to the self organization of dislocations with formation of regions of high dislocation density which envelop areas of low dislocation density, also to be regarded as domains of high plastic slip and low plastic slip activity. Due to the induced macroscopic anisotropic effects the occurrence of dislocation microstructures and their evolution have been an interesting topic for the materials science community for decades. There have been various approaches to model the formation and evolution of such microstructures which involve coupled frameworks. The difficulty in the modeling of these multi-field coupled problems is the localization of the corresponding field which yields numerical instabilities.

In order to remedy the ill-posedness of post critical results during the formation of microstructures several models have been proposed. A complete understanding of models which can simulate the patterning of dislocation slip or formation of dislocation substructures is not at hand. To contribute to this, inspired by the success of phase field models, an approach is proposed to illustrate the ability of non-convex field models to predict the emergence and evolution of dislocation slip microstructures in a rate dependent strain gradient crystal plasticity framework. The slip law used in this context differs from the classical ones in the sense that it includes the non-convex free energy term leading to the patterning of this field. The non- convexity is treated as an intrinsic property of the free energy of the material. The derivations and implementations are done in a 1D setting which allows for a thorough mechanistic understanding. The extension to 2D and multiple slip is discussed as well, whereby the non-convexity originates from the slip system interaction.

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